

- 38 -

CLAIMS

1. A gallium nitride compound semiconductor light-emitting device comprising:

a crystalline substrate (10);

a light-emitting layer (15) of a quantum well structure which is formed of a gallium nitride compound semiconductor barrier layer and a gallium nitride compound semiconductor well layer, which light-emitting layer is provided on a second side of the crystalline substrate;

a contact layer (17) formed of a Group III-V compound semiconductor for providing an Ohmic electrode for supplying device operation current to the light-emitting layer; and

an Ohmic electrode (18) which is provided on the contact layer and has an aperture through which a portion of the contact layer is exposed,

wherein the Ohmic electrode exhibits light permeability with respect to light emitted from the light-emitting layer, and the well layer contains a thick portion having a large thickness and a thin portion having a small thickness.

2. A gallium nitride compound semiconductor light-emitting device according to claim 1, wherein the well layer contains a portion having a thickness of 1.5 nm to 0 nm.

- 39 -

3. A gallium nitride compound semiconductor light-emitting device according to claim 1 or claim 2, wherein either the barrier layer or the well layer is doped with an impurity element.

4. A gallium nitride compound semiconductor light-emitting device according to claim 3, wherein only the barrier layer is doped with an impurity element.

5. A gallium nitride compound semiconductor light-emitting device according to claim 4, wherein the predetermined impurity element added only to the barrier layer is silicon.

6. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 5, wherein the contact layer (17) is doped with an n-type impurity element and has a carrier concentration of $5 \times 10^{18} \text{ cm}^{-3}$ to $2 \times 10^{19} \text{ cm}^{-3}$.

7. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 6, wherein the contact layer (17) is doped with a p-type impurity element and has a carrier concentration of $1 \times 10^{17} \text{ cm}^{-3}$ to $1 \times 10^{19} \text{ cm}^{-3}$.

8. A gallium nitride compound semiconductor light-emitting device according to claim 7, wherein the contact layer (17) is doped with a p-type impurity element and has

- 40 -

a carrier concentration of $1 \times 10^{17} \text{ cm}^{-3}$ to $5 \times 10^{18} \text{ cm}^{-3}$.

9. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 8, wherein the contact layer (17) has a thickness of 1 μm to 3 μm .

10. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 9, wherein the Ohmic electrode (18) exhibits a transmittance at the wavelength of emitted light of 30% or higher.

11. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 10, wherein the Ohmic electrode (18) has a thickness of 1 nm to 100 nm.

12. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 11, further comprising a metallic reflecting mirror (21) for reflecting light emitted from the light-emitting layer (15) to the outside, which mirror is provided on a first side of the crystalline substrate (10), wherein the metallic reflecting mirror (21) contains a metallic material identical to that contained in the Ohmic electrode (18).

13. A gallium nitride compound semiconductor light-emitting device according to claim 12, wherein the

- 41 -

metallic reflecting mirror (18) has a multilayer structure including a metallic film which contains a metallic material identical to that contained in the Ohmic electrode (18).

14. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 13, wherein the metallic reflecting mirror (21) contains a single-metal film or an alloy film formed from at least one member selected from the group consisting of silver, platinum, rhodium and aluminum.

15. A gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 14, wherein the metallic reflecting mirror (21) is in the form of multilayer film.

16. A light-emitting diode employing the gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 15.

17. A lamp employing the gallium nitride compound semiconductor light-emitting device according to any one of claims 1 to 15 or the light emitting diode according to claim 16.